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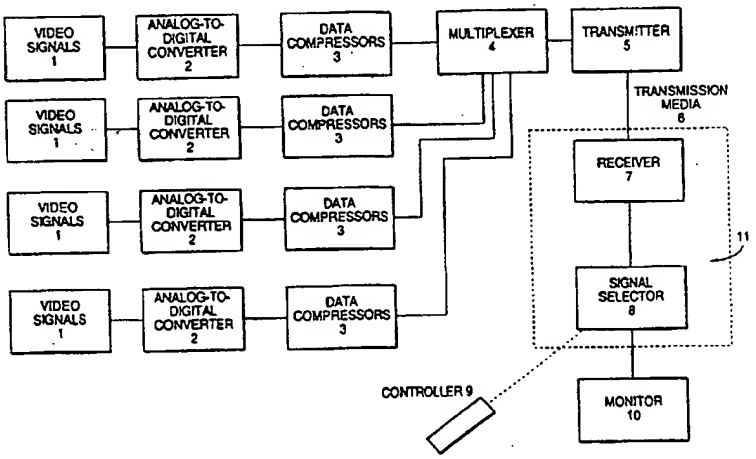


(57) Abstract

An interactive cable television system is disclosed which utilizes a standard cable television distribution network for simultaneously providing a plurality of viewers with an interactive television program comprising a plurality of signals related in time and content. Video signals (1) are transmitted in a digital format, more than one signal being multiplexed onto a data stream on a single channel. The video signals (1) may be compressed for efficiency. A receiver (7), in conjunction with a signal selector (8), selects a particular NTSC channel for playback, then selects a particular video signal from the data stream, and decompresses the video signal for playback. Seamless switching between video signals on different channels is provided. An alternative embodiment is disclosed wherein the various signals which comprise the interactive program are switched at the head end (300) rather than at the receiver (7). The multiple choice control unit (9) selects a desired signal by relaying the multiple choice selections of the user through a relay box (17) back to a remotely located switching station. The switching station routes the correct video signal down the appropriate cable channel for the particular user.

COMPRESSED DIGITAL-DATA INTERACTIVE PROGRAM SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to interactive response systems, and more particularly to an interactive television system which provides interactive programming using compressed, digital data having more than one video signal on a broadcast channel, or a multiplexed signal within a digital format, or both. The invention also relates to seamlessly switching between video signals while viewing a first video signal, even though the video signal switched to may be on a different broadcast channel, or on the same channel multiplexed with, the currently viewed video signal.

2. Description of the Prior Art

Interactive systems are well known in the art. By synchronizing parallel tracks of an information storage media, and relating the content of the various tracks, it was found that interactive activity could be simulated. For example, commonly owned Freeman, U.S. Patent No. 3,947,972 discloses the use of a time synchronized multi-track audio tape to store educational conversations. One track is employed to relay educational interrogatories to a user, and the remainder of the tracks, selectable by a switching mechanism, are used to convey responsive messages.

These systems progressed to interactive television, wherein multiple broadcast or cable channels were switched in response to user selections to provide interactive operation. Commonly owned Freeman, U.S. Patent No. 4,847,700 discloses an interactive television system wherein a common video signal is synched to a plurality of audio channels to provide content related to user selectable responses.

The video signals are converted into digital format for transmission. In a digital format, it is possible to transmit more than one video signal per cable television channel. Further, it is possible to transmit video signals via conventional telephone lines. If desired, the various digital video signals may be compressed before transmission. Compression allows an even larger number of video signals to be transmitted over a channel of the transmission media. A multiplexer combines the various digital signals into a reduced number of transmission data streams for transmission. The various NTSC television channels may be allocated in a predetermined fashion to maximize the number of simultaneously transmittable signals. The multiplexer in conjunction with the television transmission system multiplexes the desired data streams onto the desired channels, and transmits these signals over the NTSC channels. The number of video signals which may be multiplexed onto a data stream on a single transmission channel will vary depending on the video signals to be transmitted. The television channels containing a data stream of multiplexed video signals may be transmitted over a standard cable television distribution network, or direct broadcast satellite transmission system. A receiver receives one or more television channels, some or all containing a multiplexed data stream of video signals or non-multiplexed digital video signals, and in conjunction with a signal selector, selects a particular data channel/ data stream for playback, then selects a particular video signal from the data stream's multiplexed signal, and finally expands the video signal, if necessary, for playback to a television monitor.

A multiple choice controller operates to control the receiver and signal selector to select a particular video signal for playback. If more than one channel is received, the multiple choice controller may be programmed to map the different channels, and the multiple signals thereon, to a serial numerical channel representation to simplify use by the user. The signal selector includes the necessary expansion apparatus corresponding with the compression scheme in use.

In practice, a user selects a desired interactive program to be viewed. Using the multiple choice controller, the user selectably responds to information displays or interrogatory messages and the signal selector selects a particular multiplexed

transmission media for the particular user. In such an arrangement, only a single link is required between the subscriber or receiver and the head end so that the one channel link can be used to receive a plurality of different channel selections dependent on the interactive choice relayed from the receiver to the video switch at the head end.

If desired, the two-way link may be used for other purposes, such as to transmit user demographic data back to the programming source for commercial reasons, or to allow an interactive game show player to win prizes, for example.

The system of the present invention allows improved performance during switching, making the channel switches transparent. When a channel change is required by a user response to an interactive interlude, a slight imperceptible delay is programmed to allow the expansion algorithm an opportunity to adjust to the rapid change from one video signal to another.

During the delay, previously obtained video information is displayed while the interactive system locates, receives, demultiplexes, decompresses, decodes, and processes the new video signal. This allows the interactive system to switch to the new video signal without flicker or distortion appearing on the TV screen, i.e., a seamless switch.

Disclosed are different methods to achieve this seamless switching. One involves an analog video frame buffer. Another uses two tuners. Other alternatives include: (a) using two digital video buffers; (b) using a large memory; (c) using a large buffer in an embodiment similar to that of (b); and (d) switching at the cable headend.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a block diagram of the Interactive Television System of the present invention.

FIGURE 2 is a block diagram of the system of the present invention in a two-way transmission configuration.

FIGURE 3 is a block diagram of one embodiment to achieve seamless switching between video signals.

FIGURE 4 is a block diagram showing an alternative embodiment to achieve seamless switching between video signals.

video is about 80 Gbytes. Since there are 30 frames/sec in such video, the data transfer rate is 22 Mbytes/sec. This large amount of data is preferably reduced by digital compression.

In order to reduce the data transfer requirements, the various digital video signals are preferably compressed before transmission. The video may be compressed by any conventional compression algorithm, the two most common types being "processor intensive" and "memory intensive."

The processor intensive approach performs compression by eliminating non-changing aspects of a picture from the processing in the frame-to-frame transfer of information, and through other manipulations of picture information involving mathematical computations that determine the degree to which a given motion in a picture is perceptible to the human eye. This approach depends on high-speed processing power at the transmission point.

The memory approach involves division of a picture frame into hundreds of minuscule blocks of pixels, where each block is given a code representing its set of colors and variations in luminance. The code, which is a much smaller increment of information than all the information that would describe a given block of the picture, is transmitted to the receiver. There, it calls up the identically coded block from a library of blocks stored in the memory of the receiver.

Thus, the bit stream represents a much smaller portion of the picture information in this approach. This system is generally limited by the variety of picture blocks which may be stored in the receiver, which relates directly to memory size and microprocessor power.

Examples of commonly known compression techniques which may be used with the invention are JPEG, MPEG1 and MPEG2.

Data Compressors 3 are provided to reduce the data for each video signal which must be transmitted. Data compressors 3 may be of any conventional type commonly known in the art for compressing video images, such as those previously described. Compression of the various video signals might be done with fewer data compressors 3 than one compressor per video signal. In a conventional analog NTSC system, by way of example, it is customary to transmit

video signals that are preferably related in time and content. The frequency corresponding to a third channel might contain a digital data stream of an interactive movie consisting of four multiplexed compressed video signals which are related in time and content. The frequency corresponding to a fourth channel might contain an analog NTSC signal relating to local programming. Therefore, using the invention, four NTSC channels could contain a channel of multiplexed movies, an interactive sports program, an interactive movie, and local programming.

Multiplexer 4 receives the incoming compressed, digitized video signals and in a predetermined conventional fashion, in conjunction with transmitter 5, multiplexes the desired video signal onto the desired channels, and transmits these signals over the NTSC channels. Certain NTSC channels may contain only one video or other signal, in analog or digital form.

As indicated earlier, the number of video signals which may be multiplexed onto a data stream on a single transmission channel will vary. Also, the number of channels which use data streams may vary. The transmission data streams are transmitted by transmitter 4 via transmission media 6 to a receiving station 7. The transmitter 4, media 6, and receiver 7 may be any conventional means for transmitting digital video signals including broadcast television, cable television, direct broadcast satellite, fiber optic, or any other transmission means. Alternatively, the invention may be self-contained in a stand-alone system, as explained below.

The transmission means may also be a telephone system transmitting a digital video data stream. Thus, a multiplexed data stream containing several broadcast channels or an interactive program with related video signals may be sent directly to a user over a single telephone line. The aforementioned digital transmission devices may include means for transmitting analog signals as well. In one of the preferred embodiments, the digital transmission signal is transmitted using a cable television system. Receiver 7 receives various NTSC channels, some or all containing multiplexed or non-multiplexed digital video signals. Ordinarily, more than one channel will be transmitted by transmitter 5 and received by receiver 7 as in an ordinary cable television system. However,

separate channel displays for the user which, when the viewer makes choices on the multiple choice controller, a seamless switch occurs therebetween. Each video signal of this interactive program may include a label which reads, for example, "Full-Screen Action -- Press A: Close-up Action -- Press B: Replay -- Press C: Statistics -- Press D."

As shown, if more signals were needed for an interactive program than were mappable to a data stream on a single channel, signal selector 8 in conjunction with receiver 7 may be programmed to switch between the various video signals 1 as well as the various broadcast channels to provide the necessary level of interactivity. However, preferably all the various video signals associated with a particular interactive program are multiplexed onto a single channel. Additionally, the signal selector 8 may store information relating to current and previous user responses. For example, the personal profile of the viewer or previous response patterns of the viewer could be stored in memory. This information may be used in conjunction with commands transmitted within the video signals, as discussed in patent No. 4,6502,279, incorporated herein by reference. The stored personal profile information and received commands may be used to switch interactively between data streams and video signals without any additional response from the user.

The multiplexed interactive program may be transmitted over a single telephone line, if desired. In this embodiment, multiple choice controller 9 is programmed to switch between the various video signals on the single telephone line. If additional channels were desired, a two-way configuration is used as described below.

The system of the present invention may be utilized in an educational embodiment. In this embodiment, information is stored on each data stream in a plurality of reproducible information segments, each of which comprises a complete message reproducible by the receiver directly in response to the selection of the video signal by signal selector 8 responsive to a user selection on multiple choice controller 9. Each of the information segments in the various data streams contain interrogatory messages with associated multiple choice

unit 9 relays the multiple choice selections of the user through a relay box 17 back to the remotely located switching station 14. The multiple choice selections may be relayed by relay box 17 to the switching station by any conventional means, such as two-way cable television, telephone, or FM transmission. Switching station 14 receives the multiple choice selection of the user and routes the desired signal to transmitter 5 which conventionally transmits the desired video signal down the appropriate cable channel for the particular user. If desired, transmitter 5 may also transfer conventional programming on the cable television channels not being used for interactive programming. Alternatively, switching station 4 may include multiplexing equipment as previously described, and thus operate multiple interactive or noninteractive programs over a single television channel. For example, if it were desired to implement the interactive football game program as previously described, a single NTSC cable channel may be allocated for the program. However, in this instance, the video signals would be present at the transmitting end. In response to a signal from wireless controller 9, a signal is sent by relay box 7 to the cable TV switching station which routes the desired video signal to the requesting viewer. Such a system requires very fast switching equipment, but can be implemented using digital imagery.

Alternatively, it may be desirable to transmit the interactive sporting event over a single telephone line. When the user enters a selection on controller 9, a signal is sent via the telephone line to the central switching station which routes the desired signal of the interactive program over the user's telephone line so that a single link handles both the interactive choice being made at the receiver and the transmission of that choice, out of a plurality of choices, from the head end where the actual switching takes place in response to the interactive selection made at the receiver.

The two-way link between the user and the switching station may be used for other purposes. For example, demographic data may be transferred from the user to the broadcast network for commercial purposes, such as targeted advertising, billing, sending a game show winner a winning number for pickup of a prize, or other commercial or non-commercial purposes.

After passing through the frequency agile modulators 220, 222, 224, 226, 228, the signals from video signal bus 250 progress through the cable (or broadcast TV) system 260. The signals may pass through RF feed 262 and amplifier 230. The user's set top box 232, 234, 236, containing a frequency agile demodulator, is tuned to the frequency of the associated frequency agile modulator 220, 222, 224, 226, 228. The decoded signal from the set top box 232, 234, 236 is displayed on television monitor 10.

When a user desires to interact, the user issues a command on the controller 9. The command is received by the set top box 232, 234, 236. A user request is sent back down the cable or other transmission system 260 to one of the remote switches 210, 212, 214, 216, 218. At the appropriate time, based on the user request and the algorithm for interactivity which accompanies the program, the remote switch makes a cut during a vertical blanking interval from one signal on bus 250 to another signal on bus 250. The result of this switch is modulated by one of the frequency agile modulators 220, 222, 224, 226, 228 and sent down the virtual channel to the user, who sees a seamless cut from one image to the other as a result of the interaction. The signal delivered to the user may be full bandwidth or compressed video. Likewise the video signal on the bus 250 delivering the simultaneous signal to the multiple remote switches 210, 212, 214, 216, 218 may be compressed video. This embodiment allows for a relatively low cost remote user box because the most costly switching equipment is located at the headend and each remote switch may be allocated to any user. Therefore, the cost is spread over the larger population of users.

As an example, it is assumed that the signal received by receiver 206 is placed on bus line 270 of the video signal bus 250 and is forwarded to set top box 236 and displayed on monitor 10. At some point the set top box 236 causes a user request to be generated. The user request is based on a current or past entry on controller 9 and/or information stored in set top box 236 (e.g., information stored could be previous user response information or personal profile information). The cable TV system 260 may amplify the user request at amplifier 230 while carrying the user request back to frequency agile modulator 226, which communicates the request to remote switch 216. During the vertical blanking interval, the remote

over time. Similar circuit elements appearing in Figures 3-5 are referred to by using the same reference numbers.

Figure 3 shows an embodiment which allows for a seamless video switch between two or more separate digital video signals. As shown in Figure 3, a microprocessor 108 is connected to RF demodulator 102 and digital demultiplexer 106. The microprocessor 108 directs demodulation and demultiplexing of the proper channel and data stream to obtain the correct video signal. The proper channel is determined either by examination of the user's input from user interface 130 and/or any other information or criteria (such as personal profile information) stored in RAM/ROM 120. For example, the RAM/ROM 120 could store commands provided within the video signals as discussed in patent No. 4,602,279, and incorporated herein by reference. The user interface 130 may be an infrared, wireless, or wired receiver that receives information from multiple choice control unit 9.

The RF demodulator 102 is part of the receiver 7, and demodulates data from the broadcast channel directed by the microprocessor 108. After the data stream is demodulated, it passes through a forward error correction circuit 104 into a digital demultiplexer 106. The demultiplexer is controlled by microprocessor 108 to provide a specific video signal out of a number of video signals which may be located within the data stream on the demodulated broadcast channel. The demultiplexed video signal is then decompressed and decoded by decompressor/decoder 110. The decompressor/decoder 110 includes a digital to analog converter to convert the decompressed signal into an analog signal. The analog video signal is synchronized by a sync add circuit 150 and a sync generator 140. The analog video signal is then buffered by an analog video frame buffer 160. The buffered video signal is modulated by a modulator 170 into a NTSC compatible signal.

By using an analog video frame buffer 160 and delaying the viewing of a given signal, enough time is allowed for the decompressor/decoder 110 to lock onto, decompress, convert to analog, and wait for the resultant vertical interval of a second video signal. For example, assume video signal A is currently being processed and transferred through the circuit shown in Figure 3 and displayed on

signal. As long as the buffer is large enough to keep the first video running while the second video is being decompressed and decoded, a seamless switch will occur.

Figure 4 shows an alternate, dual tuner embodiment for seamless switching between separate video signals. In this embodiment, the microprocessor 108 controls the selection of the RF channel that is demodulated by RF demodulators 102A, 102B. The demodulated data streams enter the forward error correctors 104A, 104B. At the output of the forward error correctors, the data streams are transmitted to the input of the digital demultiplexers 106A, 106B.

As with the RF demodulators 102A, 102B, the digital demultiplexers 106A, 106B are controlled by the microprocessor 108. This configuration allows the microprocessor 108 to independently select two different individual time-multiplexed video signals on different channels and data streams. If all the video signals of an interactive program were contained on a single channel or data stream, it would only be necessary to have a single RF demodulator, forward error corrector, and digital demultiplexer serially connected and feeding into the two digital video buffers.

Two data streams are provided from the digital demultiplexers 106A and 106B. One data stream carries video information pertaining to the video signal the user is currently viewing. The second data stream carries the video signal selected based on the user's previous and/or current interactive selections from the user interface 130, as determined by the microprocessor 108.

The digital information on each of the two streams is buffered in digital video buffers 164, 165. The buffered signals are then decompressed and converted into analog signals by decompressors/ decoders 110A, 110B which include digital to analog converters. The decompressors 110A, 110B are preferably MPEG decoders.

A local sync generator 140 is connected to sync add 151, 152 and frame sync 153, 154 circuits. Because both streams are synchronized based on signals from the same local sync generator 140, each stream becomes synchronized to the other. In particular, the signals on each stream are frame synchronized.

receive and demultiplex two data streams on different frequency channels. One buffer is used to store previously received video signals, while the other buffer quickly passes through the selected video signals.

Based on the same assumptions above, video signal A is progressing through the upper branch of the circuit and it is desired to switch to video signal C. However, in this alternative embodiment, digital video buffer 164 is providing maximum buffering to video signal A.

Because it is desired to switch to video signal C, microprocessor 108 directs the alternative circuit (containing a single RF receiver 102, single forward error corrector 104 and single digital demultiplexer 106 connected in serial), to receive and demultiplex the data stream on which video signal C is located, which may be different than that of video signal A. When video signal C is demultiplexed, the microprocessor 108 directs digital video buffer 165 to provide minimum buffering of video signal C so that decompressor/decoder 110B may quickly decompress and decode the digital signals. After decompression and decoding, video signal C is synchronized with video signal A. At this time video signal A is read for display from digital video buffer 164. The digital video buffer 164 must be large enough to provide video frames for output during the time it takes the RF demodulator and digital demultiplexer to switch to video signal C and the time required for decompression, decoding, and synchronization of video signal C.

When video signal C is synchronized with video signal A, the microprocessor directs VBI switch 180 to switch from video signal A to video signal C in the vertical blanking interval of video signal A, thereby providing a seamless and flicker-free switch.

At this time, digital video buffer 165 will begin to utilize maximum buffering by altering its fill/empty rate as described above with respect to the Figure 4 embodiment. When adequate buffering is achieved, a switch to another video signal may be performed in the same manner as described above.

Another preferred embodiment is shown in Figure 5. This embodiment also includes an RF demodulator 102, a forward error corrector 104, and a digital demultiplexer 106. However, the circuitry differs along the rest of the chain to

stream it was decoding, the microprocessor 108 starts to fill up the memory 190 with video signal C packets until it is determined that a full sequence of I, B and P frames are available. As soon as the valid sequence is in memory the microprocessor 108 moves the memory read pointer to the start of a valid sequence of C video signal packets so that the decompressor decoder can successfully decode the C signals. This results in a seamless switch from video signal A to video signal C.

This embodiment requires a data channel for enabling a synchronous switch between a first video stream and a second video stream. This data channel comprises the ACTV codes which link together the different program elements and information segments on the different video signals. In addition, the data channel also comprises synchronization pulses and a time code to signify to the pointer the proper time to skip from a memory location representing one video signal to a memory location representing another video signal in order to enable a seamless switch.

The microprocessor 108 reads the data signal from the digital demultiplexer 106 and communicates pertinent data to the sync add circuit 150, which is connected to sync generator 140. The microprocessor 108 is then able to synchronously communicate with the memory 190.

The time code sent will identify the timing for one picture, as well as for multiple pictures, and will lock the different pictures together. This is done through the use of similar clocks at both the transmission end and the receiver. A time code is used in order to keep the two clocks at both the transmission and receive end synchronously connected to one another. Once the clocks at both ends are working synchronously, each of the multiplexed video streams must be synchronized to the clocks. In order to synchronize the multiplexed video stream to the clocks, each of the individual channels must be referenced to a common reference point and must be identified.

In the preferred embodiment, a packet header would be incorporated into the transport layer of the MPEG signal to identify the various channels. The packet header will also include information as to where to insert the vertical blanking interval. In MPEG, the vertical blanking interval is not transmitted from the

At time T4, compressed video signal c_4 is stored. The A_5 frame is presented for output at the pointer location. At time T5, c_5 is stored, while the data is again shifted and a_6 is ready for output.

In this example, the microprocessor 108 immediately recognizes channel C data c_6 and C_7 at times T6 and T7, and continues to shift the data in memory without moving the pointer. Therefore, channel A data frames a_7 and A_8 are output to the decompressor/decoder 110. At time T8, there is enough channel C data to begin a decoding sequence, assuming that the decompressor/decoder 110 requires three frames (c,c,c) which reference two frames (C,C) for decompression and decoding purposes. Therefore, at time T8, the pointer is moved to point to frame C_3, which will be the next frame output to the decompressor/decoder 110. Frame C_3 is used in the decompression and decoding of one or more of frames c_4, c_5, and c_6.

Rather than outputting the compressed video signals individually, the group of C_3, c_4, c_5, c_6, and C_7 may be output to the decompressor/decoder 110 at once. This is the preferable technique where C_7 is required to decode preceding frames (i.e. c_4, c_5 or c_6).

As with the examples described previously and shown in Figures 3 and 4, the buffer may alter its fill and empty rates to provide maximum buffering. If this is performed, the pointer will be reset to its original position, as shown in Figure 6 at time Tn.

Using Figures 3-6, and the previous description of memories and buffers, the artisan will be able to provide a seamless switch for flicker-free switching between interactive channels of the interactive television system of this invention. Other variations using the above schemes are also possible, as realized by the artisan of ordinary skill.

Although the present invention has been described in detail with respect to certain embodiments and examples, variations and modifications exist which are within the scope of the present invention as defined in the following claims.

channels carrying either a single one of said program information message signals or said multiplexed interactive television program information signal; each of said multichannel television receivers (7, 17, 232, 234, 236) independently receiving and selecting any of said plurality of program information message signals dependent on the television reception channel selected and the signal selected therefrom, each of said multichannel television receivers (7, 17, 232, 234, 236) comprising a demultiplexing multichannel selection means (106, 106A, 106B) for demultiplexing said multiplexed interactive television program information signal and selecting the television reception channel associated frequency to be received, signal selection means (8, 9, 108, 130, 120) for selecting a particular program information message signal from said demultiplexed interactive television program information signal, decompression means (110, 110A, 110B) or decompressing said compressed digital format of said selected program information message signals, said decompression means (110, 110A, 110B) requiring an adjustment period upon switching from a first selected multiplexed program information message signal to a next selected multiplexed program information message signal, each of said program information message signals having a designated position indicator in said demultiplexing multichannel selection means (106, 106A, 106B); and

means, connected to the decompression means (110, 110A, 110B), for providing a delay (8, 160, 232, 300) for a time corresponding to said adjustment period during a switch from said first selected multiplexed program information message signal to said next selected multiplexed program information message signal of said multichannel interactive program for allowing said decompression means (110) a period of time to adjust to said switch and to thereby enhance the efficiency of said decompression means (110), said delay (8, 160, 232, 300) providing means effecting a delay for said adjustment period in response to selection of said next selected multiplexed program information message signal, said demultiplexing multichannel selection means (106, 110) decoding said next selected multiplexed program information message signal in response to selection of said next selected multiplexed program information message signal, said multi-information interactive television program communication signal

5. An interactive television system according to claim 1 wherein said transmitted interactive television programming further comprises at least one regular broadcast television signal having an associated communication frequency, said television programming transmission means (5, 260) further comprising means (15,300) for substantially simultaneously providing said at least one regular broadcast television signal to said subscriber distribution network on said associated communication frequency, said multichannel television receivers (7, 17, 232) adapted to receive said at least one regular broadcast television signal on a channel corresponding with said associated frequency.

6. An interactive television system according to claim 5 wherein said multiplexed interactive television program information signal further comprises said at least one regular broadcast television signal.

7. An interactive television system according to claim 1 wherein said subscriber distribution network is a one way television signal distribution network.

8. An interactive television system comprising a plurality of subscriber television reception systems (7, 17, 232) each of said subscriber television reception systems comprising a television receiver, each of said television receivers having a plurality of television reception channels, each of said television reception channels having a different associated communication frequency;

a television subscriber distribution network connected to said plurality of subscriber television reception systems (7, 17, 232); and

a television programming transmission means (5, 260, 262, 300) connected to said television subscriber distribution network for providing transmitted interactive television programming thereto, said television subscriber distribution network providing said transmitted interactive television

wherein subscribers in said interactive television system independently select and view said interactive television programming received on a multiplexed reception channel and switch between the program information message signals of said interactive television programming without a visually perceptible delay during said interactive television programming.

9. An interactive television system according to claim 8 wherein said television programming transmission means (5, 260, 262, 300) further comprises a plurality of different regular television program information signals along with said compressed digital multiplexed multi-information television program communication signal, each of said different regular television program information signals having an associated communication frequency, more than one of said associated regular television program information signal communication frequencies adapted for the same associated program information message signal frequencies, each of said different regular television program information signals multiplexed with at least a portion of said program information message signals, each of said different regular television program information signals directly selectably receivable by said signal selection means (8, 9, 262, 300) and displayable on a corresponding television reception channel.

10. An interactive television system according to claim 8 wherein said television subscriber distribution network is selected from the group consisting of cable television, telephone, broadcast television, and direct broadcast satellite.

11. An interactive television system according to claim 8 wherein said multi-information selection means (232) comprises keyboard means comprising a plurality of keys for selectably enabling conversion of any one of said associated communication frequencies of said simultaneously provided different regular television program information into said television reception channel associated frequencies dependent on the key selected.

subscriber distribution network connected to said plurality of subscriber television reception systems; the improvement comprising:

a television programming transmission means (5, 260, 262, 300) connected to said subscriber distribution network for providing transmitted interactive television programming thereto, said subscriber distribution network providing said transmitted interactive television programming to said plurality of subscriber television reception systems, said television programming transmission means (5, 260, 262, 300) comprising means for substantially simultaneously providing a multi-information interactive television program communication signal as said transmitted interactive television programming to said subscriber distribution network; said multi-information interactive television program communication signal comprising a plurality of simultaneously provided different program information message signals related in real time and content to each other;

switching means (8, 9, 108, 120, 130) for selecting one of said plurality of simultaneously provided different program information message signals responsive to a control signal corresponding to a particular television receiver for transmitting said selected signal to said particular television receiver (7), said control signal received over a transmission media, said means for substantially simultaneously providing a multi-information interactive program further comprising said switching means (8, 9, 108, 120, 130); each of said television receivers (7) independently selecting and receiving any of said plurality of program information message signals dependent on the program information message signal selected, each of said television receivers comprising signal selection means (8, 9, 108, 120, 130) for generating and transmitting said control signal to said subscriber distribution network for signalling said switching means to transmit a particular program information message signal from said plurality of program information message signals to said television receiver (7) said switching means requiring an adjustment period in switching from a first selected channel to a next selected channel to properly reconstruct the signal on said next selected channel, said signal selection means (8, 9, 108, 120, 130) further comprising means for providing a delay corresponding to said adjustment period

consisting of two-way cable television, two-way telephone, and two-way direct broadcast satellite.

20. An improved interactive television system according to claim 25 wherein said control signal transmission media is selected from the group consisting of telephone, cable television, FM transmission, and digital fiberoptic.

21. An improved interactive television system according to claim 25 wherein each of said program information message signals has a designated position indicator in said multichannel selection means;

at least one of said program information message signals further comprising video information displayable on said multichannel television receiver corresponding to informational labels to be dynamically assigned to said designated position indicators for a particular multi-information interactive television program, said television displayable informational labels dynamically variable dependent on the content of a said multi-information interactive television program.

22. An improved interactive television system according to claim 21 wherein said displayable informational labels dynamically vary according to the successive decision tree selections to be made.

23. An improved interactive television system according to claim 16 wherein said program information message signals are in a digital format.

24. An improved interactive television system according to claim 23 wherein said digital program information message signals are compressed.

25. An improved interactive television system according to claim 16 wherein said television receivers are multichannel television receivers, each of said multichannel television receivers having a plurality of different television reception channels, each of said television reception channels having a different

a means for displaying (10) said selected program information message signal;

wherein subscribers in said interactive television system independently select and view said interactive television programming.

27. An interactive television system according to claim 26 wherein said multi-information packets comprise one or more regular television program signals.

28. An interactive television system according to claim 26 wherein said subscriber distribution network is selected from the group consisting of cable television, telephone, broadcast television, and direct broadcast satellite.

29. An interactive television system according to claim 26 wherein said multi- information selection means (8, 108) comprises keyboard means comprising a plurality of keys for selectably enabling reception and selection of a program information message signal on a communication frequency corresponding to a selected key and the corresponding communication frequencies.

30. An interactive television system according to claim 29 wherein said multi-information packets comprise video information displayable on said television receiver corresponding to information labels to be dynamically assigned to said keys for a particular multi-information packet, said information labels dynamically variable dependent on the content of said particular multi-informational packet.

31. An interactive television system according to claim 26 wherein at least a portion of said program information message signals are content related in a decision tree relationship between successive individual packets.

communication frequencies, each interactive television program signal comprising a data stream containing a plurality of digitally compressed video signals, the reception system comprising:

a user interface (9, 130) for receiving subscriber selections;

a microprocessor (108), connected to the user interface (9, 130), for selecting a video signal and directing a seamless switch to the selected video signal;

a multi-frequency receiver (7), comprising an RF demodulator for tuning to one or more frequencies and demodulating an interactive television program signal on the tuned-to frequency;

a means for demultiplexing (106) the demodulated interactive television program signal to obtain the selected video signal;

a decompressor/ decoder (110), connected to the demultiplexer 106, for decompressing the selected video signal and converting the decompressed signal into a standard video signal;

a synchronization means (140, 150, 152, 154, 153), connected to the decompressor/ decoder, for synchronizing the standard video signal;

a frame buffer (160), connected to the synchronization means, for buffering the synchronized standard video signal; and

a modulator (170), connected to the frame buffer, for modulating the buffered standard video signal into a standard video broadcast signal;

a means, connected to the modulator, for displaying (10) said selected video signal; and

wherein subscribers in said interactive television system independently select and view said interactive television programming.

35. An interactive television system comprising:

a subscriber television reception system for receiving interactive television programming, the interactive television programming comprising one or more interactive program signals placed at one or more communication frequencies, each interactive television program signal comprising a data stream containing a plurality of digitally compressed video signals, the reception system comprising:

containing a plurality of digitally compressed video signals, the reception system comprising:

a user interface (130) for receiving subscriber selections;

a microprocessor (108), connected to the user interface for selecting one of the video signals and directing a seamless switch to the selected video signal;

a multi-frequency receiver (7) for tuning to one or more frequencies and receiving an interactive television program signal on the tuned-to frequency;

a means for demultiplexing (106) the received interactive television program signal to obtain selected video signals;

a memory (190), connected to the demultiplexing means, for storing the demultiplexed video signals, the memory containing a pointer under microprocessor control which identifies the memory contents to be output;

a decompressor/ decoder (110), connected to the memory, for decompressing the stored video signals and converting the decompressed signals into standard video signals;

a RF encoder (170), connected to the decompressor/ decoder, for encoding the standard video signals into standard video broadcast signals; and

a synchronizing means (140, 170), for generating synchronization pulses;

a means, connected to the RF encoder (170), for displaying (10) said selected video signals; and

wherein subscribers in said interactive television system independently select and view said interactive television programming.

37. The interactive television system of claim 36, wherein the memory means is a buffer, wherein the microprocessor monitors the contents of the buffer to determine the identity of the stored video signals, and wherein the pointer is positioned at the selected video signal only when there is enough stored

receiving (7) one or more interactive selections from a user;

tuning to a communication frequency and receiving interactive program signals at the tuned communication frequency;

demultiplexing (106) the received interactive program signals to provide a compressed video signal, the demultiplexed compressed video signal determined by the step of processing program codes and the received interactive selections to determine whether it is necessary to display video data from a different time-multiplexed video signal by either selecting another communication frequency or selecting another time-multiplexed video signal;

decompressing (110) the demultiplexed video signal;

decoding (110) and synchronizing the decompressed video signal to provide a standard video signal;

buffering (160) the standard video signal, in an amount necessary to ensure seamless switching between video signals;

modulating the buffered video signal for presentation on a standard television set.

40. A method of receiving and viewing an interactive television program, where the interactive program is comprised of one or more interactive program signals located on one or more communication frequencies, wherein the interactive program signals comprise digitally compressed video signals containing video and command information, the method comprising the steps of:

receiving (130) one or more interactive selections from a user;

receiving (7) an interactive program signal;

demultiplexing (106) the received interactive program signal to obtain first and second compressed video signals;

independently decompressing and decoding (110) the first and second compressed video signals to obtain the first and second video signals;

independently frame synchronizing (153, 154) the first and second video signals to obtain first and second synchronized video signals;

RF encoding (170) the standard video signal to obtain a standard video broadcast signal;

controlling (108) the memory, memory pointer, RF demodulator (170), and demultiplexer to seamlessly switch between video signals; and

displaying (10) the standard video broadcast signal on a television.

42. The method of claim 41 wherein the step of controlling further comprises the steps of:

managing the memory contents, comprising the steps of:

buffering the memory so that the contents of the memory shift to overwrite the memory location that was most recently output;

altering filling and emptying rates of the buffering step so that the pointer may be reset to a predetermined location.

43. An interactive television system comprising:

a means for providing programming, comprising:

means for obtaining programming; and

bus means, for carrying the obtained programming on one or more bus channels;

a means for transmitting interactive television programming (300), comprising:

at least one remote switch (210), connected to the bus means, for switching from a previous bus channel to a next bus channel, wherein the switching is performed during a vertical blanking interval of the programming on the previous bus channel, and wherein the next bus channel is determined by the switch based on a user request; and

a program transmission means (5,260,262,300), connected to the remote switch means (210), for receiving a user request and communicating the user request to the remote switch, and for receiving the switched program from the remote switch and transmitting the switched program to a user on a virtual channel; and

a means, connected to the receiving means, for providing selected video signals, the selected video signals based on the user selections;

a means, connected to the providing means (170), for outputting an analog signal, comprising:

means for decompressing (110), buffering, and synchronizing the selected video signals;

a means, connected to the decompressing, buffering, and synchronizing means, and connected to the providing means, for controlling the buffering means (108), resulting in seamless switch between video signals when the providing means selects another video signal based on a user selection;

a means, connected to the decompressing, buffering, and synchronizing means, for encoding (170) the synchronized analog video signal into a format compatible with a television display; and

wherein the encoded signal is related to the user's selections and the user may interactively and seamlessly switch between video signals.

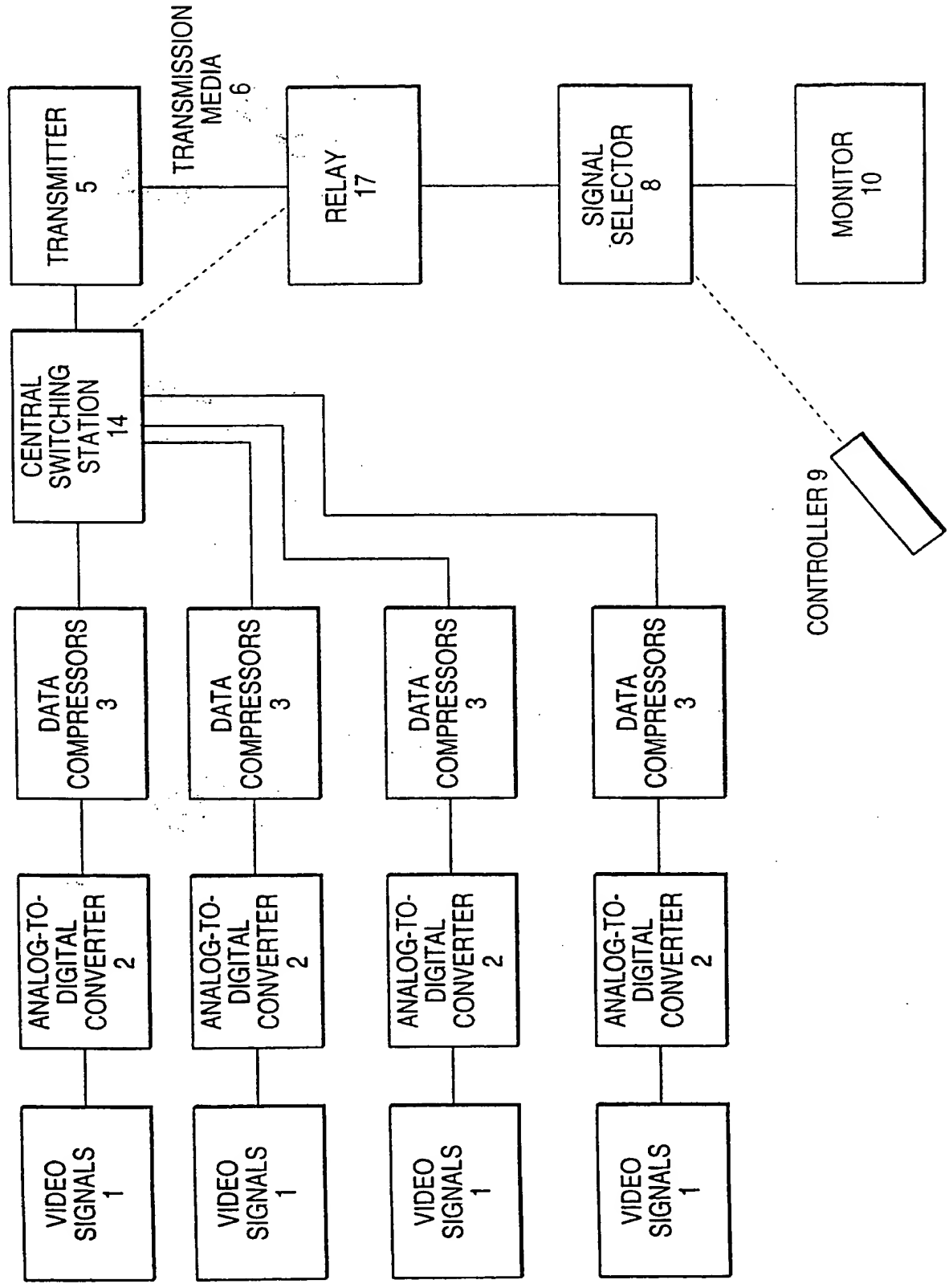

TRANSMITTER 5
TRANSMISSION MEDIA 6
RELAY 17
SIGNAL SELECTOR 8
MONITOR 10
CENTRAL SWITCHING STATION 14
CONTROLLER 9
DATA COMPRESSORS 3
DATA COMPRESSORS 3
DATA COMPRESSORS 3
DATA COMPRESSORS 3
ANALOG-TO-DIGITAL CONVERTER 2
ANALOG-TO-DIGITAL CONVERTER 2
ANALOG-TO-DIGITAL CONVERTER 2
ANALOG-TO-DIGITAL CONVERTER 2
VIDEO SIGNALS 1
VIDEO SIGNALS 1
VIDEO SIGNALS 1
VIDEO SIGNALS 1

FIG. 2

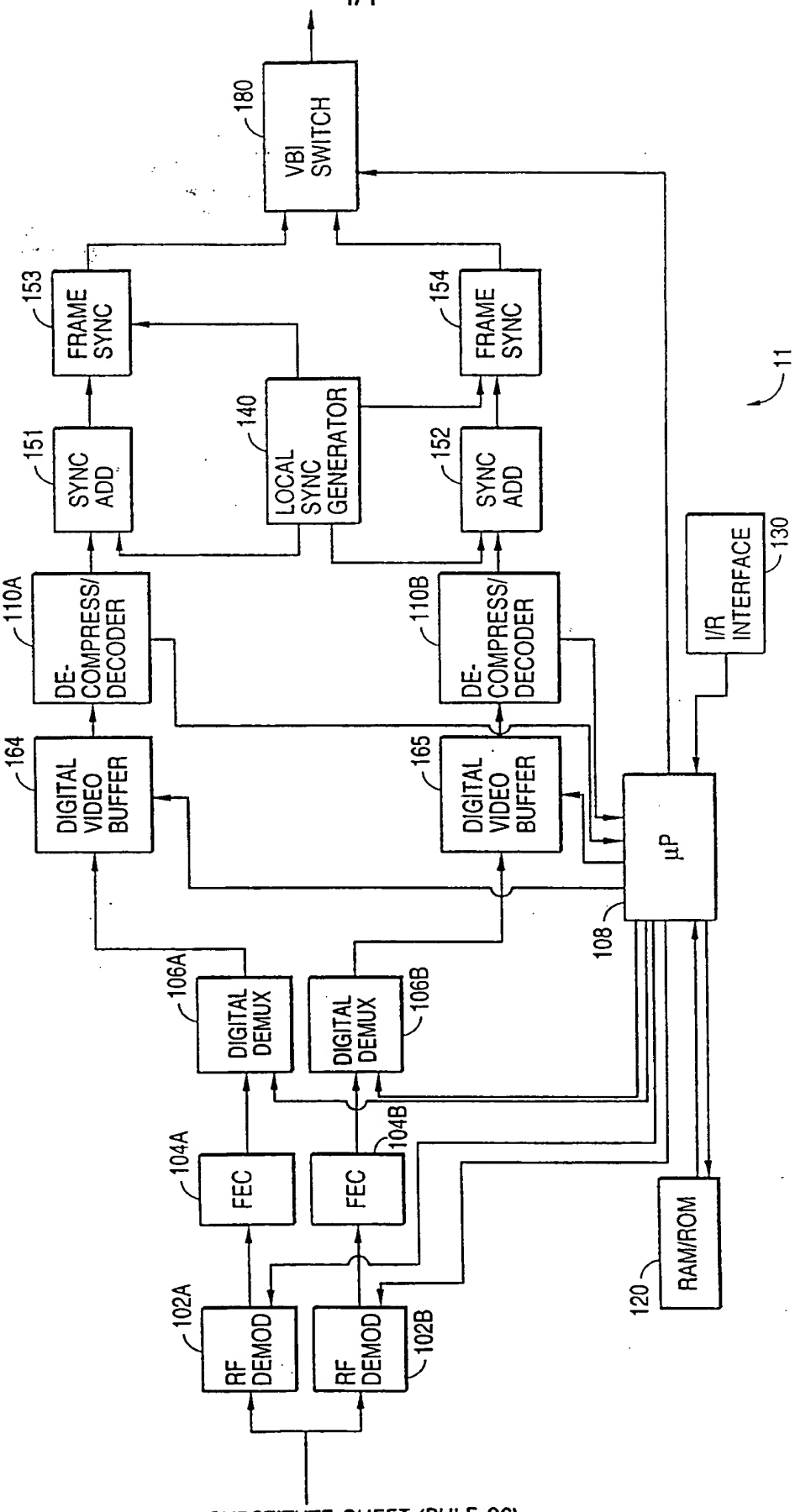
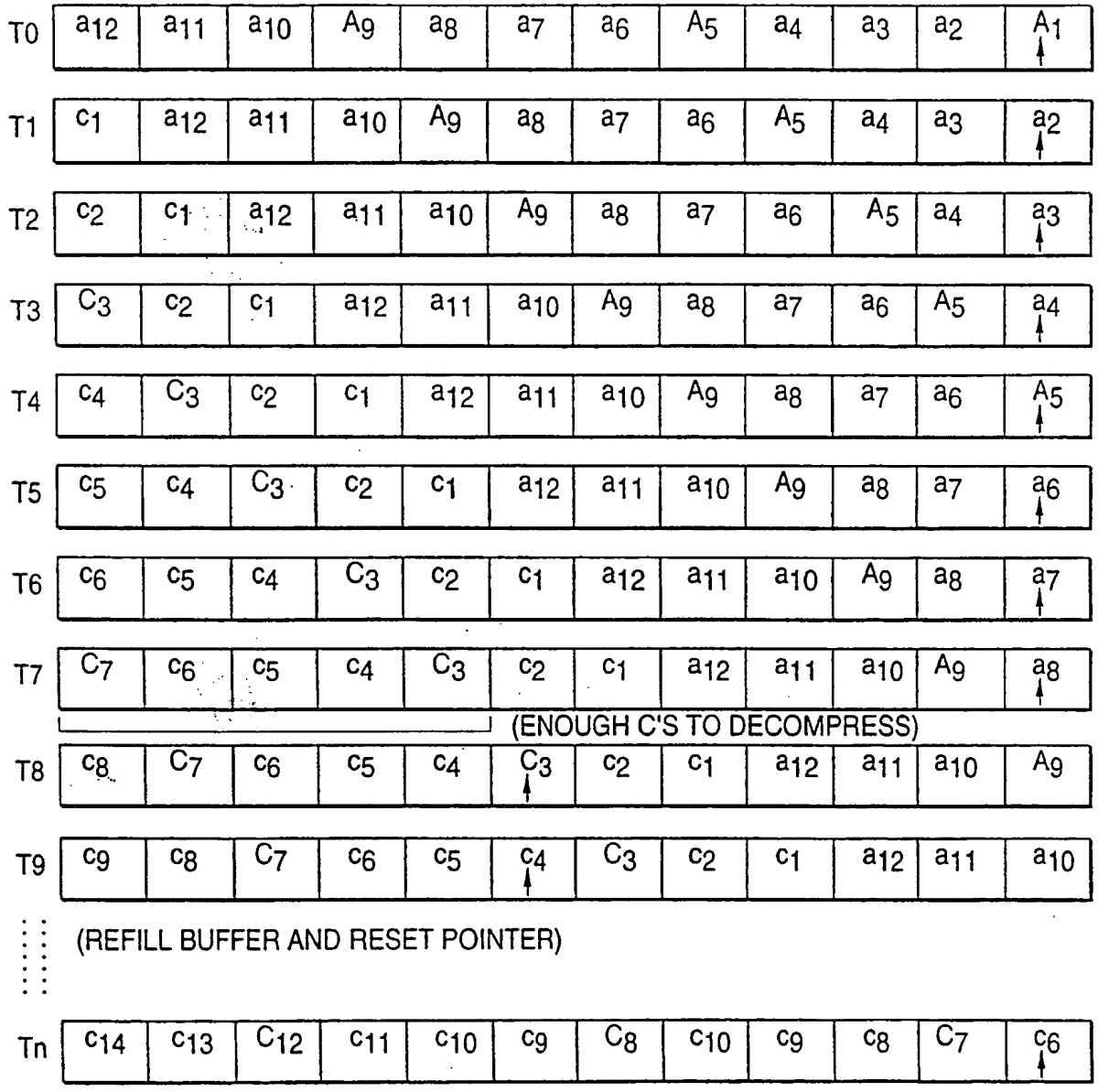

180
VBI SWITCH
153
FRAME SYNC
154
FRAME SYNC
140
LOCAL SYNC GENERATOR
151
SYNC ADD
152
SYNC ADD
11
110A
DE-COMPRESS/ DECODER
110B
DE-COMPRESS/ DECODER
130
I/R INTERFACE
164
DIGITAL VIDEO BUFFER
165
DIGITAL VIDEO BUFFER
µP
108
106A
DIGITAL DEMUX
106B
DIGITAL DEMUX
104A
FEC
104B
FEC
102A
RF DEMOD
102B
RF DEMOD
120
RAM/ROM

FIG. 4

FIG. 6



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US96/07236

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :H04N 7/14, 7/173
US CL :348/12, 13
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 348/12, 13, 6, 7, 8, 9, 10: 455/5.1, 6.1, 6.2

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

H04N 7/14, 7/173

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

NONE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A,P	US, A, 5,488,411 (LEWIS ET AL.) 30 JANUARY 1996, FIGS1-18.	1-47
A,P	US, A, 5,442,389 (BLAHUT ET AL.) 15 AUGUST 1995, FIGS. 1-11.	1-47

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be part of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 17 AUGUST 1996	Date of mailing of the international search report 11 SEP 1996
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